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Floristic diversity and vegetation analysis of *Brassica nigra* (L.) Koch communities

Nasr H. Gomaa [1*], *E. A. Al Sherif* [1, 2], *A. K. Hegazy* [3, 4] & *M. O. Hassan* [1]

[1] Department of Botany, Faculty of Science, Beni-Suef University, Beni-Suef, Egypt
[2] Biology Department, Faculty of Sciences & Arts, Khulais, King Abdulaziz University, Saudi Arabia
[3] Department of Botany, Faculty of Science, Cairo University, Giza, Egypt
[4] Department of Botany & Microbiology, College of Science, King Saud University, Riyadh, Saudi Arabia

Abstract

The floristic composition and species diversity of *Brassica nigra* communities were investigated in Beni Suef Governorate, Egypt. In 46 stands, a total of 49 species belonging to 42 genera and 18 families were recorded. Vegetation classification and ordination distinguished seven groups: two in reclaimed land only, three groups in old cultivated land only, and two that occurred in both types of land. The species that dominated these groups were *Brassica nigra*, *Sonchus oleraceus*, *Beta vulgaris*, *Cichorium endivia*, *Euphorbia helioscopia* and *Anagallis arvensis*. The highest species diversity was mainly in groups from reclaimed land, and in wheat compared to other crops. Edaphic factors, especially soil texture, $CaCO_3$ and organic carbon, contributed significantly to explaining the distribution of some weed species, but not with that of *B. nigra*. The allelopathic potential of *Brassica nigra* reported in previous studies did not seem to play a role in community composition.

Keywords: allelopathy, *Brassica nigra*, vegetation, TWINSPAN, weed diversity

Introduction

Weeds have been defined as plants that are objectionable or interfere with the activities or welfare of man (Weed Science Society of America 1994). They are nuisance to agriculture mainly because of their adverse effect on crop yields (Aldrich 1984). Weeds are one of the important components in the agroecosystems. In Egypt, many studies have suggested that weed assemblages constitute the majority of the flora in farmland (El-Bakry 1982; Mahgoub 1985; Shaltout & El Fahar 1991; El-Demerdash *et al*. 1997). The occurrence of many weed species may be related to specific farming systems maintaining suitable habitat conditions including various environmental conditions as well as agro-technical treatments such as herbicides, soil tillage, fertilizers and irrigation (Tasseva 2001, 2005). Likewise, weed diversity patterns are related to soil, climatic conditions (Sang 2009) and habitat type (Hegazy *et al*. 2004): crop type also has an effect on weed vegetation and weed diversity (Hegazy *et al*. 2004; Shaltout & El Fahar 1991).

In a plant community, soil chemistry can be affected through allelochemicals released from the dominant species, which thus can influence community structure and dynamics through their allelopathic potential (Souto *et al*. 1995; Djurdjevic *et al*. 2004). Allelochemicals may therefore play important roles in plant diversity and dominance in agroecosystems (Chou 1999). However, it is difficult to separate the action of allelopathy on crop systems from other stress conditions such as herbivorous insects, diseases, nutrients, water resources, herbicide action, etc. (Einhellig 1996). *Brassica nigra* (L.) Koch (Brassicaceae) is a widespread weed in winter crops in Egypt (Hegazy *et al*. 2004). The allelopathic effects of *Brassica nigra* have been documented in previous studies (e.g. Turk & Tawaha 2002; Turk *et al*. 2005). Recently, Hassan (2011) studied the allelopathic potential of *Brassica nigra* on the two weed species *Phalaris paradoxa* and *Sisymbrium irio* growing in Beni Suef Governorate (the study area of

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* Author for correspondence: email : *nhgomaa@yahoo.com*

the present work). He pointed out that water extracts of *Brassica nigra* tissues significantly inhibited germination and seedling growth of both weed species in the laboratory.

Phytosociological studies can provide weed biologists with the quantitative information required to develop comprehensive strategies for managing weed communities (Frick & Thomas 1992). Little is known about the composition and diversity of *Brassica nigra* communities. Thus the main goal of this study is to demonstrate the floristic composition and species diversity of *Brassica nigra* communities in relation to edaphic factors and crop type, and to assess the role of allelopathy.
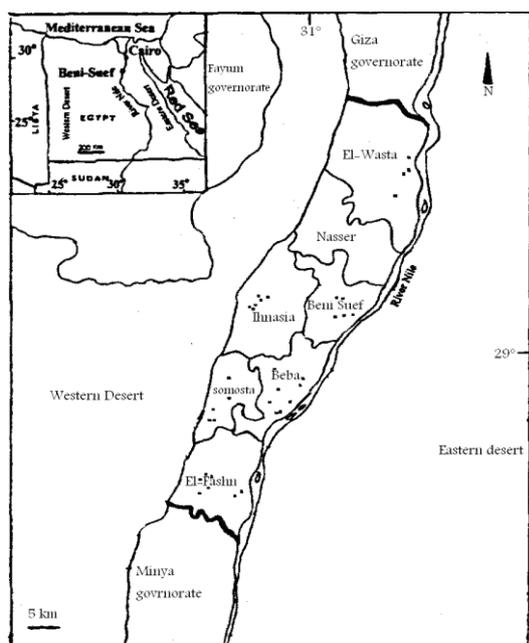

Figure 1: Map of the study area showing the location of the study sites
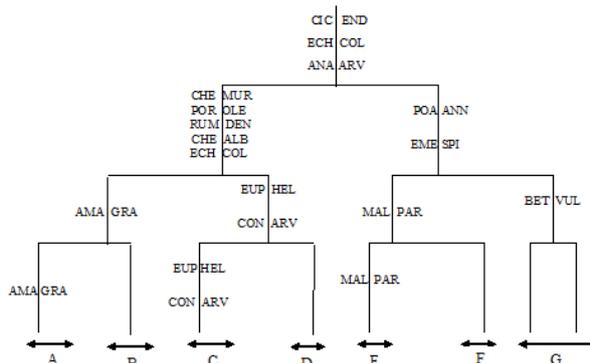
Figure 2: TWINSPAN dendrogram of 46 stands as based on the importance values of species. Indicator species names are abbreviated to the first three letters of both genus and species names. For complete names, see Table 1

Materials & Methods

The study area is Beni Suef Governorate, one of the most important agricultural centres in Egypt; much of its economy is due to agriculture and various industries. The River Nile is the main source of water used for irrigation. Cultivated land here can be separated into old cultivated land, which has been cultivated since ancient times, and reclaimed land, which has been farmed from only about 30 years ago. Located between latitudes 28° 36' to 29° 26' N and longitudes 30° 36' to 31° 21' E, with elevation ~ 32 m a.s.l., about 120 km south of Cairo, it is bounded by the Eastern and Western Deserts, and Giza (to the north) and Minya (south) (Fig.1). The total annual rainfall is 7.8 mm with the rainy season stretching from November to April. The mean monthly air temperature ranges between 12.2 ºC (January) and 29.1 ºC (July). Mean relative humidity varies between 35% (May) and 57% (December).

In winter 2008, a total of 46 stands were selected to represent the winter crops of old fields and reclaimed land where *Brassica nigra* grows. The area of each stand was 20×20 m, and in each, a floristic list and plant counts were taken from 10 randomly sampled quadrats (1×1 m each). From these, the mean relative density and relative frequency (Hegazy *et al* 1998, 2004) were calculated, as follows:

density = number of individuals / area sampled
relative density = [density of a species / total densities of all species] × 100
frequency = number of quadrats where a species occurs / total number of quadrats sampled
relative frequency = [frequency of a species / total frequency values of all species] × 100

Relative densities and relative frequencies were summed up for each species to give the Importance Value (out of 200) in each stand. Species identification and nomenclature followed Boulos (1999, 2000, 2002 & 2005).

Three indices namely species richness (*S*), the Shannon-Wiener index (*H′*) and the Evenness index (E) were used for measuring species diversity (Zhang 1995) in each stand, as follows:

species richness $\quad\quad$ S

Shannon-Wiener index $\quad H' = \sum_{i=1}^{s} - (p_i \ln p_i)$

Evenness index $\quad\quad E = \sum_{i=1}^{s} - (p_i \ln p_i)/ \ln S$

where *S* is the number of species present, *N* is the total number of individuals of all species present, N_i number of individuals of species *i*, and $p_i = N_i / N$

In each stand, three soil samples were taken from 0-30 cm depth, pooled together to give one composite sample per stand. These samples were air-dried, sieved through a 2-mm sieve and stored in paper bags until analysis. For soil texture analysis, the sieve-pipette method was followed as described by Gee & Bauder (1986), using 4% sodium hexametaphosphate and 1% sodium carbonate as a dispersing agent. Soil-water extracts of 1:5 were prepared to determine the electrical conductivity, soil pH and bicarbonate content (HCO_3^-). A conductivity meter and a glass-electrode pH meter were used for determination of electrical conductivity and soil pH, respectively. Following Jackson (1962), bicarbonates were determined by titration with 0.1 N HCl using methyl orange as an indicator, and $CaCO_3$ % was estimated by titration against 1 N HCl. Oxidizable organic carbon was determined by using the Walkely & Black rapid titration method (Black 1979).

TWINSPAN, Two Way Indicator Species Analysis (Hill 1979), was used to classify the vegetation into groups, and Detrended Correspondence Analysis (ter Braak 1987) was used to ordinate stands in two-dimensional space, both using the importance values. Soil data and diversity indices of the TWINSPAN groups were compared by one-way ANOVA followed by Duncan's *post hoc* test. Linear correlation between soil parameters and the importance value of the most common and dominant species in the study area was carried out to relate the distribution of plant species to soil parameters. Linear correlation between the importance value of *Brassica nigra* and the importance values of the two species *Phalaris paradoxa* and *Sisymbrium irio* tested how the allelopathic potential of *Brassica nigra* might affect the abundance of these species, and thereby affect community composition. The one-way ANOVA and correlation analyses were conducted using SPSS 11 for Windows.

Results

A total of 49 species belonging to 42 genera and 18 families were recorded. Members of Poaceae had the highest contribution to the total flora (8 species), followed by members of Cruciferae and Compositae (6 species each) (Table 1).

The vegetation in 46 stands was classified by TWINSPAN into seven vegetation groups (A-G, Fig. 2, Table 1). Each group comprises a set of stands that are similar in their vegetation, characterized by indicator species:

Species	TWINSPAN group						
	A	B	C	D	E	F	G
Amaranthus graecizans L. (Amaranthaceae)	8.5	-	-	-	-	-	-
Amaranthus hybridus L. (Amaranthaceae)	-	3.8	-	-	-	-	-
Amaranthus lividus L. (Amaranthaceae)	-	1.4	-	3.0	3.1	-	-
Ammi majus L. (Apiaceae)	-	-	-	-	-	4.6	-
Anagallis arvensis L. (Primulaceae)	-	0.2	-	1.17	-	22.7	8.1
Artemisia herba-alba Asso (Asteraceae)	-	0.8	-	-	-	-	-
Aster squamatous (Spreng.) Hieron. (Asteraceae)	-	-	-	0.3	-	-	-
Avena fatua L. (Poaceae)	5.7	2.1	4.7	12.9	-	5.1	-
Beta vulgaris L. (Chenopodiaceae)	24.7	30.2	21.6	8.7	3.7	10.4	13.9
Brassica nigra (L.) Koch (Brassicaceae)	49.3	25.1	21.6	49.2	38.1	19.0	27.9
Brassica tournefortii Gouan (Brassicaceae)	-	-	-	-	-	-	2.0
Capsella bursa - pastoris (L.) Medik. (Brassicaceae)	-	-	-	-	18.4	1.8	2.1
Chenopodium album L. (Chenopodiaceae)	30.9	11.1	-	6.4	10.3	10.1	17.2
Chenopodium murale L. (Chenopodiaceae)	5.0	6.2	12.7	17.7	17.8	10.4	16.6
Cichorium endivia L. (Asteraceae)	-	28.3	4.5	21.7	-	3.5	-
Convolvulus arvensis L. (Convolvulaceae)	-	2.4	14.2	1.2	2.3	5.2	4.8
Corchorus olitorius L. (Tiliaceae)	1.3	2.5	-	-	-	-	-
Coronopus niloticus (Delile) spreng. (Brassicaceae)	-	-	-	1.8	8.2	6.7	1.6
Cynodon dactylon (L.) Pers. (Poaceae)	-	-	-	1.8	-	-	-
Cyperus rotundus L. (Cyperaceae)	-	3.3	0.9	1.5		-	-
Dactyloctenium aegyptium (L.) Willd. (Poaceae)	5.6	-	-	-	-	-	-
Dinebra retroflexa (Vahl) Panz. (Poaceae)	4.6	-	-	-	-	-	-
Echinochloa colona (L.) (Poaceae)	29.1	24.5	6.0	0.5	-	-	-
Emex spinosa (L.) Cmpd. (Euphorbiaceae)	-	0.3	0.5	1.6	22.2	0.3	8.7
Euphorbia peplus L. (Euphorbiaceae)	-	0.7	-	-	-	4.1	9.0
Euphorbia helioscopia L. (Euphorbiaceae)	1.1	15.1	25.0	5.3	16.4	23.4	0.6
Euphorbia heterophylla L. (Euphorbiaceae)	-	0.8	-	4.5	-	-	-
Ganaphalium luteo - album L. (Asteraceae)	-	-	-	-	-	0.4	-
Hibiscus trionum L. (Malvaceae)	3.7	-	2.6	0.8	-	0	-
Lamium amplexicaule L. (Lamiaceae)	-	-	-	-	-	0.3	5.0
Lolium temulentum L. (Poaceae)	-	-	-	-	-	2.2	-
Malva parviflora L. (Malvaceae)	5.9	8.9	3.2	9.7	30.6	1.6	4.8
Medicago intertexta (L.) Mill. (Fabaceae)	-	-	-	-	-	1.0	-
Medicago polymorpha L. (Fabaceae)	-	-	4.1	-	-	1.5	2.7
Melilotus indicus (L.) All. (Fabaceae)	5.7	-	3.8	6.1	3.1	12.6	15.5
Oxalis corniculata L. (Oxalidaceae)	-	-	-	-	-	0.2	0.8
Phalaris paradoxa L. (Poaceae)	-	-	-	-	-	7.4	-
Poa annua L. (Poaceae)	-	-	-	-	-	2.5	18.8
Portulaca oleracea L. (Portulacaceae)	5.1	3.8	1.1	-	2.3	0.1	-
Rumex dentatus L. (Euphorbiaceae)	-	1.7	5.5	4.6	-	16.7	2.3
Silene rubella L. (Caryophyllaceae)	-	-	-	-	-	0.3	-
Silybum marinum (L.) Gaertn. (Asteraceae)	-	0.9	-	1.9	8.9	-	-
Sinapis alba L.(Brassicaceae)	-	-	3.8	3.1	-	-	-
Sisymbrium irio L. (Brassicaceae)	-	-	-	-	-	-	13.9
Solanum nigrum L. (Solanaceae)	-	2.3	3.1	-	-	0.6	-
Sonchus oleraceus L. (Asteraceae)	13.9	23.4	61.2	35.1	14.7	24.0	20.3
Spergularia marina (L.) Griseb. (Caryophyllaceae)	-	-	-	-	-	-	1.0
Stellaria pallida (Dumort.) Piré (Caryophyllaceae)	-	-	-	-	-	0.8	3.1
Trifolium resupinatum L. (Fabaceae)	-	-	-	-	-	0.7	-

Table 1: A list of the species recorded in the study area with their families and importance values in the seven vegetation groups resulted from TWINSPAN technique.

Group A comprises two stands found in reclaimed land cultivated with wheat. *Brassica nigra* was the dominant species, while *Chenopodium album* and *Bata vulgaris* were common associates. *Amaranthus graecizans* was the indicator species of this group.

Group B includes 11 stands, ten of them cultivated with Egyptian clover and the remaining one with wheat. Nine of these stands were found in old fields, while two were in reclaimed land. This group was dominated by *Beta vulgaris* and *Cichorium endivia* while *Brassica nigra, Echinochloa colona* and *Euphorbia helioscopia* were the common associated species. No indicator species were recorded for this group.

Group C represents four stands in old fields. Three of them were cultivated with Egyptian clover and the remaining one with wheat. *Sonchus oleraceus* was the dominant

species, while the associated species were *Euphorbia helioscopia*, *Brassica nigra* and *Beta vulgaris*. The indicator species characterizing this group were *Euphorbia helioscopia* and *Convolvulus arvensis*.

Group D represents eight stands (two in wheat and six in clover) and all stands were found in old fields. *Brassica nigra* was the dominant species while *Cichorium endivia*, *Sonchus oleraceus* and *Chenopodium murale* were common associated species. No indicator species were recorded for this group.

Group E comprises two stands, one in reclaimed land cultivated with wheat and the other in the old fields with clover. *Brassica nigra* was the dominant species, whereas *Malva parviflora* and *Emex spinosa* were the common associates. No indicator species were recorded for this group.

Group F includes 14 stands representing various crops as follows: nine in wheat, three in barley, one in beet and one in clover. All of these stands were found in old fields. *Sonchus oleraceus*, *Euphorbia helioscopia* and *Anagallis arvensis* were recorded as dominant species in this group, whereas *Brassica nigra*, *Rumex dentatus*, *Melilotus indicus* and *Chenopodium murale* were the common associated species.

Group G comprises five stands. All were recorded in reclaimed land cultivated with wheat. This group is dominated by *Brassica nigra*, while *Beta vulgaris* is the indicator species. *Sonchus oleraceus*, *Poa annua*, *Chenopodium murale*, *C. album* and *Melilotus indicus* were the common species.

Ordination of the 46 stands given by DCA indicated that the vegetation groups produced by the TWINSPAN classification were distinguishable and showed a clear pattern of segregation on the ordination plane, but some groups overlapped. The TWINSPAN groups were distributed clearly along the axis 1 from left to right in the following order: B, D, A, C, E, G and F (Fig. 3).
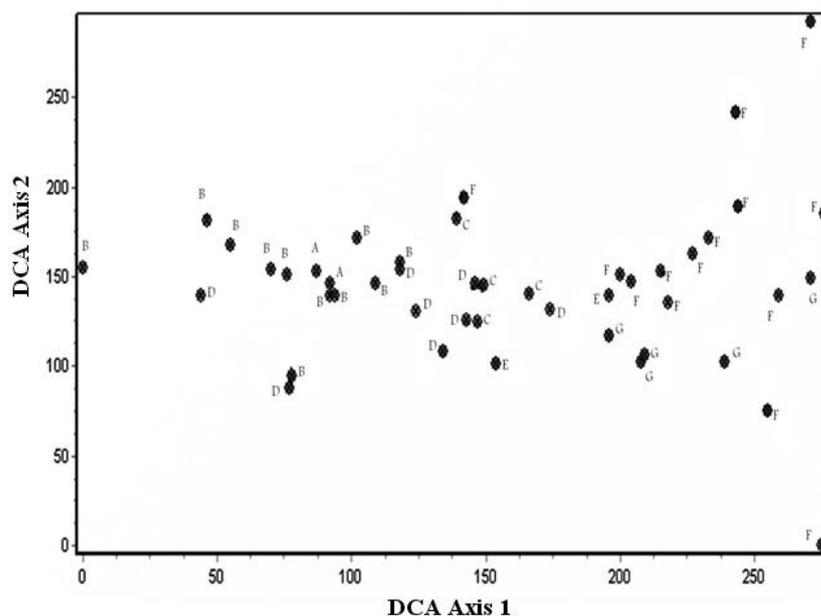

Figure 3: Ordination of 46 stands with the TWINSPAN groups superimposed.

Generally, the highest species diversity as measured by Shannon-Wiener index, species richness and evenness was recognized in group A followed by group G and group F: the lowest diversity was recorded in group E (Table 2). There were significant differences in most of the

measured soil parameters among the vegetational groups (Table 3). Group G, B and E attained the highest organic carbon percentages, while group A showed the lowest value. The highest $CaCO_3$ percentage was recorded in groups E and A. Soil pH varied from 8.7 in group A to 8.2 in group G. There were no significant differences in the values of HCO_3^- and electric conductivity among the different TWNSPAN groups, but there were for soil texture. Group A and G had the highest sand percentages, and the lowest silt values. The maximum silt percentage was in group E, while group B had the maximum clay percentage.

Species diversity	vegetation group						
	A	B	C	D	E	F	G
Shannon index(H')	2.1 b ± 0.5	1.8 ab ± 0.3	1.8 ab ± 0.2	1.8 ab ± 0.2	1.6 a ± 0.15	2.0 ab ± 0.2	2.1 b ± 0.3
Species richness (S)	14.0 c ± 2.8	10.9 ab ± 1.8	10.5 ab ± 1.0	10.5 ab ± 1.3	10.0 a ± 1.4	12.6 abc ± 1.7	13.0 bc ± 2.0
Evenness index (E)	0.8 a ± 0.1	0.8 a ± 0.2	0.8 a ± 0.1	0.8 a ± 0.1	0.7 a ± 0.03	0.8 a ± 0.1	0.8 a ± 0.1

Table 2: Means ± SD of species diversity indices for the different vegetation groups. Values in a row sharing the same letter are not significantly different at the 0.05 level.

Soil parameter	vegetation group						
	A	B	C	D	E	F	G
pH	8.6 b ± 0.05	8.3 ab ± 0.32	8.4 ab ± 0.09	8.3 ab ± 0.09	8.5 ab ± 0.11	8.4 ab ± 0.3	8.2 a ± 0.32
Electric conductivity (mS/cm)	0.2 a ± 0.07	0.3 a ± 0.1	0.2 a ± 0.06	0.3 a ± 0.12	0.3 a ± 0.06	0.5 a ± 0.73	0.7 a ± 0.25
HCO_3^- (%)	0.07 a ± 0.02	0.09 a ± 0.04	0.11 a ± 0.04	0.07 a ± 0.02	0.08 a ± 0.01	0.09 a ± 0.03	0.07 a ± 0.03
Organic carbon (%)	0.49 a ± 0.01	1.54 ab ± 0.4	1.43 ab ± 0.5	1.38 ab ± 0.4	1.48 ab ± 0.3	1.39 ab ± 0.4	2.06 b ± 1.9
$CaCO_3$ (%)	7.6 bc ± 0.5	4.8 ab ± 2.6	3.2 a ± 0.5	4.2 ab ± 2.5	9.6 c ± 9.3	3.9 ab ± 1.1	3.9 ab ± 1.2
Sand (%)	78.3 b ± 1.8	54.8 a ± 4.3	54.5 a ± 2.4	59.8 a ± 9.5	57.0 a ± 6.2	55.5 a ± 6.7	77.0 b ± 10.4
Silt (%)	1.7 a ± 0.6	22.9 b ± 7.6	24.7 b ± 2.06	22.7 b ± 5.8	25.2 b ± 2.07	22.8 b ± 6.5	7.2 a ± 8.8
Clay (%)	20.0 ab ± 2.4	22.3 b ± 4	20.8 ab ± 2.5	17.5 ab ± 4.4	17.8 ab ± 8.3	21.8 ab ± 3.3	15.8 a ± 2.1

Table 3: Soil characteristics of the vegetation groups. Values in a row sharing the same letter are not significantly different at the 0.05 level.

Some of the correlations of the importance values of the dominant and the most common species with the soil characters (Table 4) were significant. Sand is negatively correlated with *Euphorbia helioscopia* and *Sonchus oleraceus* and positively correlated with *Chenopodium album*. By contrast, silt is negatively correlated with *Chenopodium album* and positively correlated with *Euphorbia helioscopia* and *Sonchus oleraceus*. *Chenopodium album* is positively correlated with organic carbon while *Sonchus oleraceus* is negatively correlated with $CaCO_3$. *Brassica nigra* did not show any significant correlation with the measured soil properties.

No significant correlations were observed between the importance values of *Brassica nigra* and those of the two weed species, *Phalaris paradoxa* ($r = -0.18$, $p>0.05$) and *Sisymbrium irio* ($r = -0.02$, $p>0.05$).

Species	Soil parameter							
	pH	E C	HCO_3^-	Organic carbon	$Ca CO_3$	Sand	Silt	Clay
Anagallis arvensis	-0.078	0.216	-0.019	0.05	-0.100	-0.048	0.027	0.059
Beta vulgaris	0.110	0.114	0.179	-0.09	-0.035	0.129	-0.15	-0.003
Brassica nigra	0.150	-0.250	-0.260	-0.080	0.116	0.164	-0.110	-0.175
Chenopodium album	-0.040	0.045	-0.250	0.302*	0.219	0.299*	-0.400**	0.121
Cichorium endivia	0.029	-0.130	0.023	-0.08	0.096	-0.017	0.071	-0.108
Chenopodium murale	-0.382**	0.638**	-0.130	0.110	-0.010	0.247	-0.250	-0.074
Emex spinosa	-0.070	0.200	-0.130	0.070	0.634**	0.260	-0.110	-0.414**
Euphorbia helioscopia	0.052	-0.150	0.213	-0.090	-0.077	-0.400**	0.333*	0.269
Malva parviflora	-0.060	-0.020	0.029	0.059	0.137	-0.082	0.140	-0.092
Sonchus oleraceus	0.137	-0.240	0.106	0.14	-0.340*	-0.30*	0.304*	0.105

*$P < 0.05$, **$P < 0.01$ (no correction for multiple testing)

Table 4: Linear correlation coefficients (*r*) between the soil parameters and the importance value of the most common species in the study area.

Discussion

Vegetation of *Brassica nigra* communities in Beni Suef Governorate was classified into seven groups, two (A, G) in reclaimed land, three (C, D, F) in old cultivated land, and two (B, E) in both types of land. The species that dominate these groups were *Brassica nigra*, *Sonchus oleraceus*, *Beta vulgaris*, *Cichorium endivia*, *Euphorbia helioscopia* and *Anagallis arvensis*. These species have been reported to dominate or co-dominate weed communities in various regions of Egypt (El-Bakry 1982; Shaltout *et al*. 1992; El-Demerdash *et al*. 1997; Hegazy *et al*. 2004).

   Brassica nigra is a dominant species in groups A, D, E and G, and is one of the common associated species in groups B, C and F. The ability of *B. nigra* to dominate weed communities may be attributed to: (1) the deeply buried seeds that remain viable for about 50 years under field conditions (DiTomaso & Healy 2007); (2) the seed testa that is relatively hard and can protect the seed from external conditions; (3) the sticky nature of the seeds when becoming wet that enables them to disperse by attachment to equipment, vehicles or working farmers (Brooks 2004); and (4) the allelopathic potential of *B. nigra*. Bell & Muller (1973) attributed the dominance of *B. nigra* in annual grasslands of Southern California to allelopathy. Generally, Chou (1999) reported that dominance of a certain species may be attributed to allelopathy. However, the non-significant correlations between the importance value of *B. nigra* and those of *Phalaris paradoxa* and *Sisymbrium irio* indicate that the inhibitory allelopathic effect of *Brassica* on these two species (proved in the laboratory by Hassan, 2011) did not seem to affect their abundance, and hence did not seem to play a role in community composition. This could be attributed to (1) the higher densities of crop plants that effectively reduce the dose of allelochemicals produced from *Brassica* roots to species in the field (El-Khatib 2000; Weidenhamer 2006); and (2) other factors such as crop type, crop and weed management practices and soil characters may interfere with the role of allelopathy and contribute also to weed community structure and composition. Some allelopathic studies showed that allelopathy has no significant role under field conditions, and laboratory bioassays may have no ecological meaning for many communities (Stowe 1979; Heisey & Delwiche 1985).

   Sonchus oleraceus is the dominant species in group C and F, and is one of the common associated species in groups D and G. It is a prolific seed producer that can produce a large

number of seeds per plant. In addition, fruits possess fine pappi that enable them to disperse readily by air. The seeds possess no innate dormancy, and therefore they germinate once dispersed from the parent plant (Widderick *et al.* 2010). *Beta vulgaris* is the dominant species in group B, and it is one of the common associated species in groups A and C. This plant can produce seeds with a hard, rough and persistent pericarp that protects the seeds from external hazards and allows dispersal by animals and birds by either exozoochory or endozoochory. *Cichorium endivia* is dominant in group B, and it is one of the common associated species in group D. This species dominates mainly in Egyptian clover fields. Hegazy *et al.* (2004) attributed its dominance in clover fields to its discoid stem that enables this species to survive even after several cuttings of the crop. *Euphorbia helioscopia* is a dominant species in group F, and is one of the common species in groups B and C. Hegazy *et al.* (2005) showed that *Euphorbia helioscopia* produces its flower buds early in its lifespan and continuously grows, and produces flowers, fruits and seeds. Production of flower buds starts early in the growing season to ensure some seed production even if the growing season is cut. *Anagallis arvensis* is a dominant species in group F. It produces a relatively large number of flowers per plant. About 35 to 40 seeds per seed capsule (fruit) can be produced (Guyot *et al.* 1962). The seeds are able to remain dormant in the soil for about 10 years in arable soil (Brenchley & Warington 1936) and seed longevity in natural soil may extend from 6 to 7 years (Guyot *et al.* 1962). The seeds can be dispersed by birds (Salisbury 1961).

Groups A, F and G exhibited higher species diversity compared to the other groups. This can be explained as follows: (1) two of these groups (A & G) represent reclaimed land, and (2) wheat is the common crop in these groups. Hegazy *et al.* (2004) attributed the higher species diversity in reclaimed land compared to old cultivated land to (a) addition of great amounts of natural manure to reclaimed land that may increase diversity (Mt. Pleasant & Schlater 1994) because the seeds of many species can be dispersed with manure; and (b) the sandy texture of reclaimed land requires more irrigation and this give a good chance for the germination and growth of many weed species. The high weed diversity in wheat crops may be caused by (a) the single harvest made for this crop at the end of the growing season, enabling weeds to remain alive for longer to complete their life cycles compared to other crops (e.g. Egyptian clover is subjected to several cuttings per season, reducing weed diversity: Hegazy *et al.* 2004); (b) El-Hadidi & Fayed (1995) also related the greater weed assemblages associated with wheat to the ancient cultivation of this crop (introduced to Egypt some 5 millennia ago).

The present study showed that soil factors especially soil texture, $CaCO_3$ and organic carbon affect the distribution of some weed species. The significant role of the edaphic factors on the weed vegetation has been reported by several workers (e.g., El-Demerdash *et al.* 1997; Hegazy *et al.* 2004 & 2008).

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الملخص العربي

التنوع الفلوري وتحليل الغطاء النباتي لمجتمعات نبات الكبر

نصر حسن جمعه¹، احمد كامل حجازى†²، عماد على الشريف‡¹ و محمود عمر حسن¹

¹قسم النبات، كلية العلوم، جامعة بنى سويف، بنى سويف، مصر

²قسم النبات، كلية العلوم، جامعة القاهرة، الجيزة، مصر

†قسم النبات والميكروبيولوجي، كلية العلوم، جامعة الملك سعود، الرياض، المملكة العربية السعودية

‡قسم الاحياء، كلية العلوم و الاداب، خليص، جامعة الملك عبد العزيز، المملكة العربية السعودية

يهدف الهحث الى دراسة التركيب الفلوري و التنوع الحيوي لمجتمعات نبات الكبر فى محافظة بني سويف بمصر . تم دراسة الغطاء النباتى لمجتمعات الكبر فى 46 موقعا موزعة بمنطقة الدراسة باستخدام طريقة المربعات . تم تسجيل 49 نوعا نباتيا ينتمون ل 42 جنس و 18 فصيلة. و ادى استخدام التحليل الدليلى ثنائى الاتجاة (TWINSPAN) الى تقسيم الغطاء النباتى لمجتمعات الكبر الى سبعة مجموعات، هناك مجموعتان منها تمثلان الاراضي الزر اعية المستصلحة وثلاثة مجموعات تمثل الاراضي الزراعية القديمة بينما تحتوى المجموعتان الباقيتان على مواقع من   كل من الاراضي المستصلحة و الاراضي القديمة. وتضم النباتات السائدة بمنطقة الدراسة الكبر، الجعديد، السلق، السريس، الص ابون و عين القط. وتتميز الاراضي الزراعية المستصلحة بتنوع حيوى عالي عند مقارنتها بالاراضي القديمة وكذلك محصول القمح مقارنة بللمحاصيل الاخرى. وأظهرت الدراسه أن صفات التربة مثل قوام التربة و كربونات الكالسيوم والكربون العضوى لها دورا هاما فى توزيع بعض انواع الحشائش. كما اوضحت النتائج ايضا ان القدرة الاليلوباثية لنبات الكبر و المسجلة في الدراسات السابقة لا تلعب دورا اساسيا فى تركيب مجتمعات الكبر.